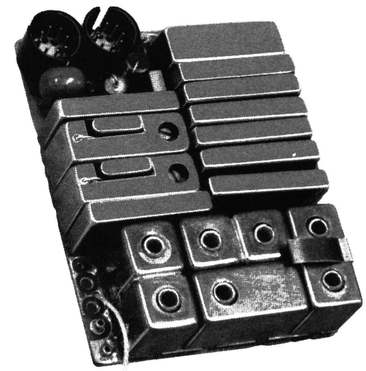
GE MOBILE RADIO

66-88 MHz RECEIVER
ER-87-A
FOR
PE MODELS AND Porta-Mobile II™

Maintenance Manual LBI 30184 A

DATAFILE FOLDER - DF1115

ER-87-A



SPECIFICATIONS *

Type Number	ER-87-A
Audio Output (EIA)	500 milliwatts at less than 5% distortion
Channel Spacing	20 kHz
Sensitivity	
12 dB SINAD (EIA Method)	0.35 μV
20 dB Quieting Method	0.50 μV
Selectivity	
EIA Two-Signal	-60 dB
Spurious Response	-70 dB
Image	-80 dB
Intermodulation (EIA)	-70 dB
Audio Response	Within +2 and -10 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
Modulation Acceptance	±6.5 kHz
Squelch Sensitivity	
Critical Squelch	0.25 kHz
Maximum Squelch	Greater than 20 dB Quieting

Maximun Frequency Spread (MHz)

Frequency	Full Performance	1 dB Degradation in Sensitivity
66-76 MHz	0.6 MHz	1.2 MHz
76-88MHz	0.8 MHz	1.6 Mhz

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate **Specification Sheet** for the complete specifications.

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS!

DESCRIPTION

Receiver Type ER-87-A models are single conversion, superheterodyne FM Receivers for operation on the 66-88 MHz bands. The complete receiver mounts on a single printed wiring board, and utilizes both discrete components and Integrated Circuit modules. The application of each model receiver is shown in the following chart:

Model Number	Freq. Range	Number of Freq.	Tone Option
4ER87A10	66-76 MHz	1 or 2	
4ER87A11	75-88 MHz	1 or 2	
4ER87A12	66-76 MHz	1 or 2	Channel Guard
4ER87A13	75-88 MHz	1 or 2	Channel Guard

References to symbol numbers mentioned in the following text are found on the Schematic Diagram, Outline Diagram and Parts List (see Table of Contents). The typical circuit diagrams used in the text are representative of the circuit used in the Integrated Circuit modules. A block diagram of the receiver is shown in Figure 1.

Supply voltages for the receiver includes a continuous regulated 5.4 Volts for the compensator module, a continuous 7.5 Volts for the squelch module, and a switched 7.5 Volts for the remaining receiver stages.

CIRCUIT ANALYSIS

OSCILLATOR MODULES A314 & A315

Oscillator Modules A314 & A315 (4EG28A30/31) consist of a crystal-controlled Colpitts oscillator (see Figure 2). An entire oscillator module is contained in a metal can with the receiver operating frequency printed on the top. The crystal frequency ranges from 17.2 - 22.2 MHz, and the crystal frequency is multiplied 5 times.

The oscillator frequency is temperature compensated to provide instant frequency compensation, with a frequency stability of ±.0002% from 0°C to +55°C and ±.0005% from -30°C to +60°C. The temperature compensation network is contained in compensator module A313.

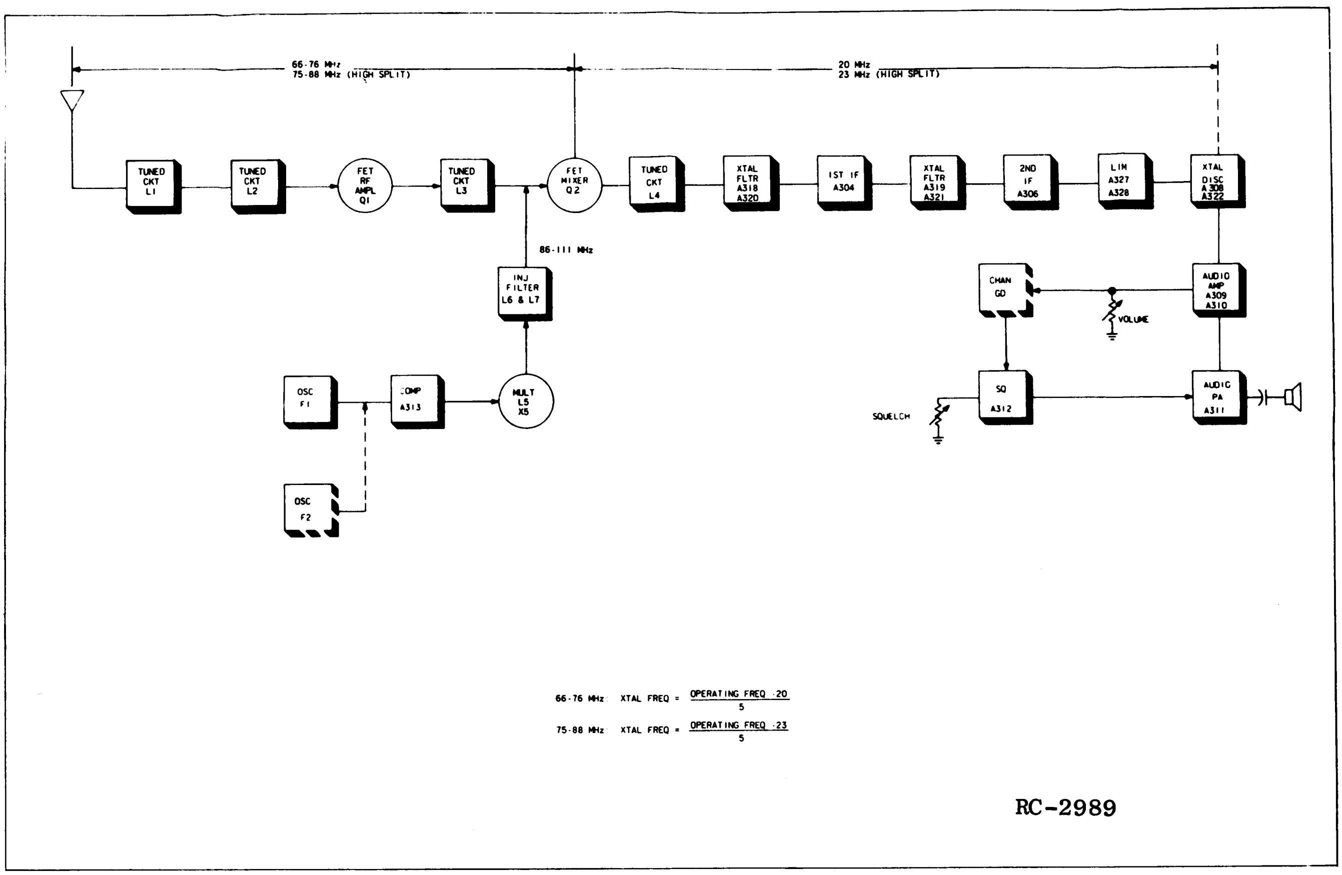


Figure 1 - Block Diagram

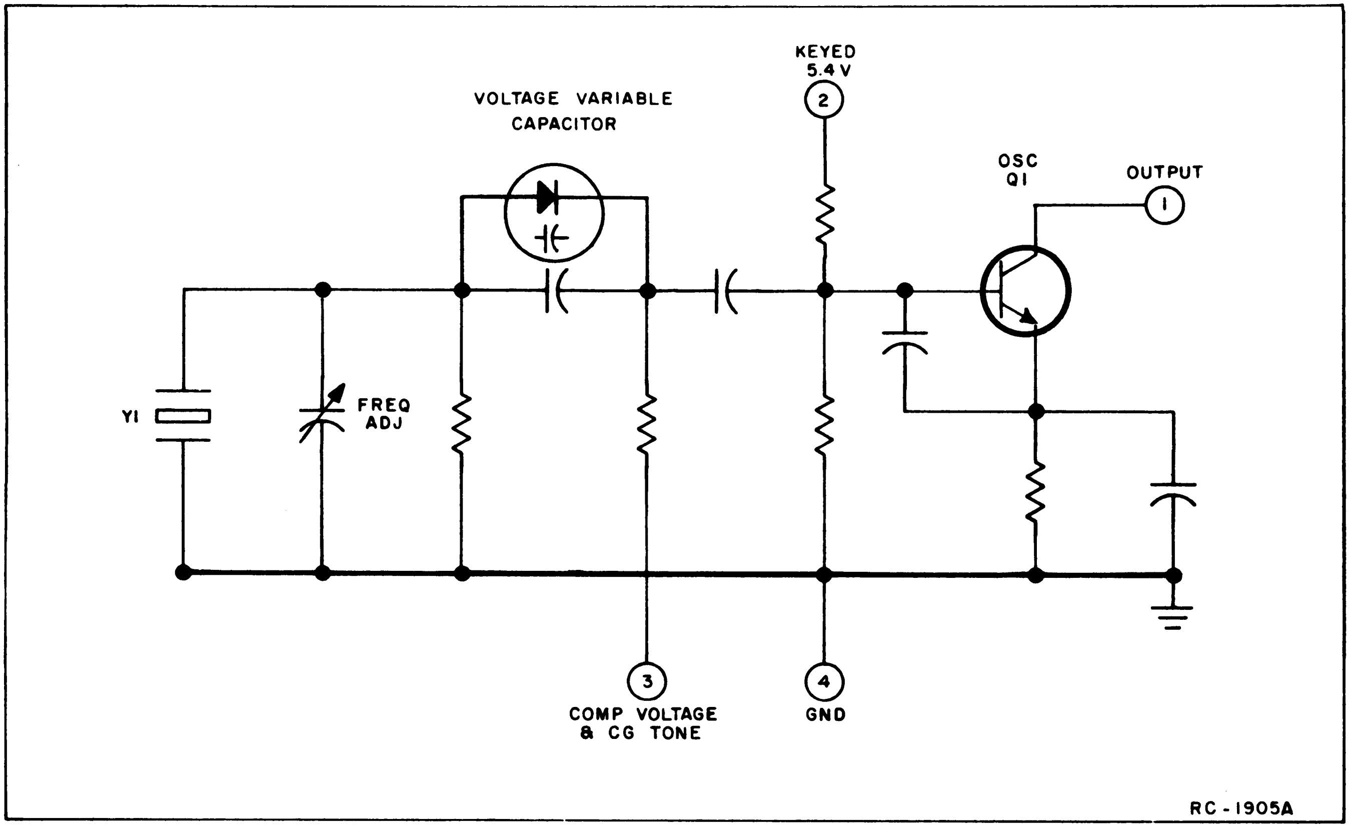


Figure 2 - Typical Oscillator Circuit

In single frequency receivers, a jumper from H10 to H11 on the system board connects the oscillator module to the continuous 5.4 Volt supply voltage. The oscillator output is applied to compensator A313.

In two-frequency receivers, an additional oscillator module is mounted on the receiver board. The single-frequency supply jumper is removed, and the proper frequency is selected by connecting the 5.4 Volts to the selected oscillator module through frequency selector switch S1 on the control unit.

NOTE

> All oscillator modules are individually compensated at the factory and cannot be repaired in the field. Any attempt to remove the oscillator cover will void the warranty.

COMPENSATOR A313

Compensator module A313 contains a buffer-amplifier stage, and the temperature compensation network for the oscillator similar to the compensator used in the transmitter (see Figure 3).

RF from the oscillator is coupled through a DC blocking capacitor to the base of Q1. The output of Q1 connects to multiplier coil L1 on the multiplier assembly.

In the compensation network, the regulated 5.4 Volts at Pin 2 is applied to a thermistor-compensated voltage divider. The output at Pin 3 (2.35 volts measured with a VTVM) is applied to Pin 3 and to the varactor in the oscillator module. At temperatures below -10°C, the compensated voltage increases to maintain the proper voltage on the oscillator voltage-variable capacitor.

SERVICE NOTE

> An abnormally low VTVM reading (or no reading) at Pin 3 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 3, raising it off of the printed board and taking another reading. If this reading is normal, the problem is in the oscillator module. If the reading remains low (or zero), the problem is in the compensator.

FRONT END A330/A331

The receiver front end consists of three tuned RF coils, a Field Effect Transistor (FET) RF amplifier stage, a multiplier stage and a FET mixer stage. The RF signal from the antenna is coupled to a tap on RF coil L1.

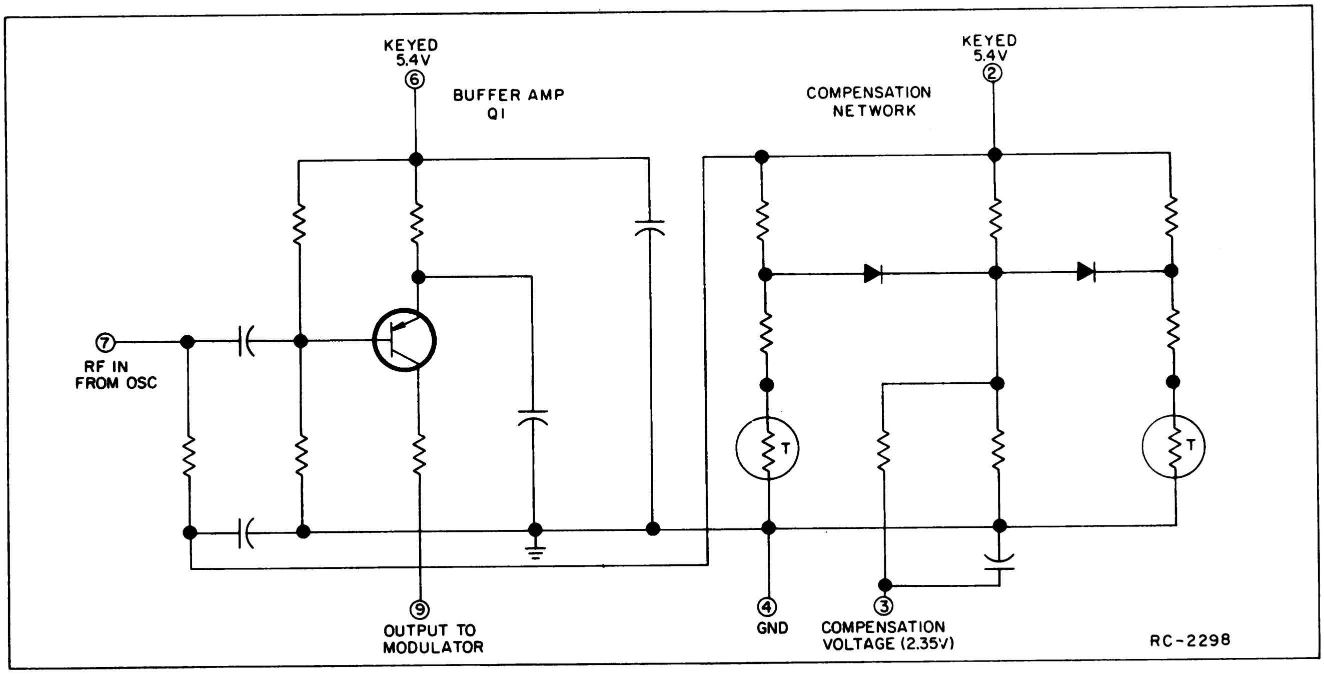


Figure 3 - Typical Compensator Circuit

RF from L1 is coupled to L2. A tap on L2 is connected to the gate of RF amplifier Q1. The output of Q1 developed across tuned circuit C5/C19, C6/C20 and L3 is applied to the gate of mixer Q2.

The output of compensator module A313 is applied to a tap on L5 in the multiplier assembly. Multiplier coil L5 is tuned to five times the crystal frequency. The injection frequency output from L5 is coupled through bandpass filter L6, L7, C11/C22, C12, C14/C23 and C15 to the gate of mixer Q2. High side injection is used.

The RF signal from RF amplifier Q1 and the high side injection frequency from the multiplier applied to the gate of mixer Q2 produces an IF of 20/23 MHz on the drain of Q2. The 20/23 MHz IF is coupled through the mixer drain tank circuit L4, C7 and C8 to the input of crystal filter A318/A320 or A319/A321.

CRYSTAL FILTERS A318 & A319/A320 & A321

Filter A318/320 follows the receiver front end and its output is applied to the 1st IF amplifier module. Filter A319/A321 follows the IF amplifier module. The two Crystal Filters provide the major selectivity for the receiver. A318 & A319/A320 & A321 provides a minimum of 85-dB stop-band attenuation.

IF AMPS A304 & A306

An IF amplifier module follows each of the crystal filters, and contain the resistor-matching networks for the filters. A typical IF amplifier circuit is shown in Figure 4.

Each of the IF amplifier modules consist of three R-C coupled amplifier stages that are DC series-connected for reduced drain. The two IF modules provide a total gain of approximately 85 dB.

LIMITER A327/A328 & DISCRIMINATOR A308/A322

Limiter A327/A328 consists of three R-C coupled limiter stages that are DC series connected for reduced drain. The Limiter module also provides some gain. The output of the Limiter is applied to the discriminator. A typical Limiter circuit is shown in Figure 5.

The receiver uses a 20/23 MHz, fixed-tuned crystal discriminator (A308/A322) to recover the audio from the IF signal. The discriminator output is applied to the audio amplifier module.

AUDIO AMPLIFIER A309/A310

Audio and noise from the discriminator is applied to audio amplifier module A309 (A310 in Channel Guard applications). A typical audio amplifier circuit is shown in Figure 6.

Audio and noise is applied to the base of Q1. This stage operates as an emitter-follower for matching the impedance of the discriminator to the amplifier stage (Q2) and the VOLUME control. The output of Q1 connects from Pin 2 to the base of amplifier Q2 (Pin 4) through the VOLUME control. The output of Q1 is also applied to the input of the Squelch module.

Following amplifier Q2 is an active low-pass filter (Q3). Audio from the filter

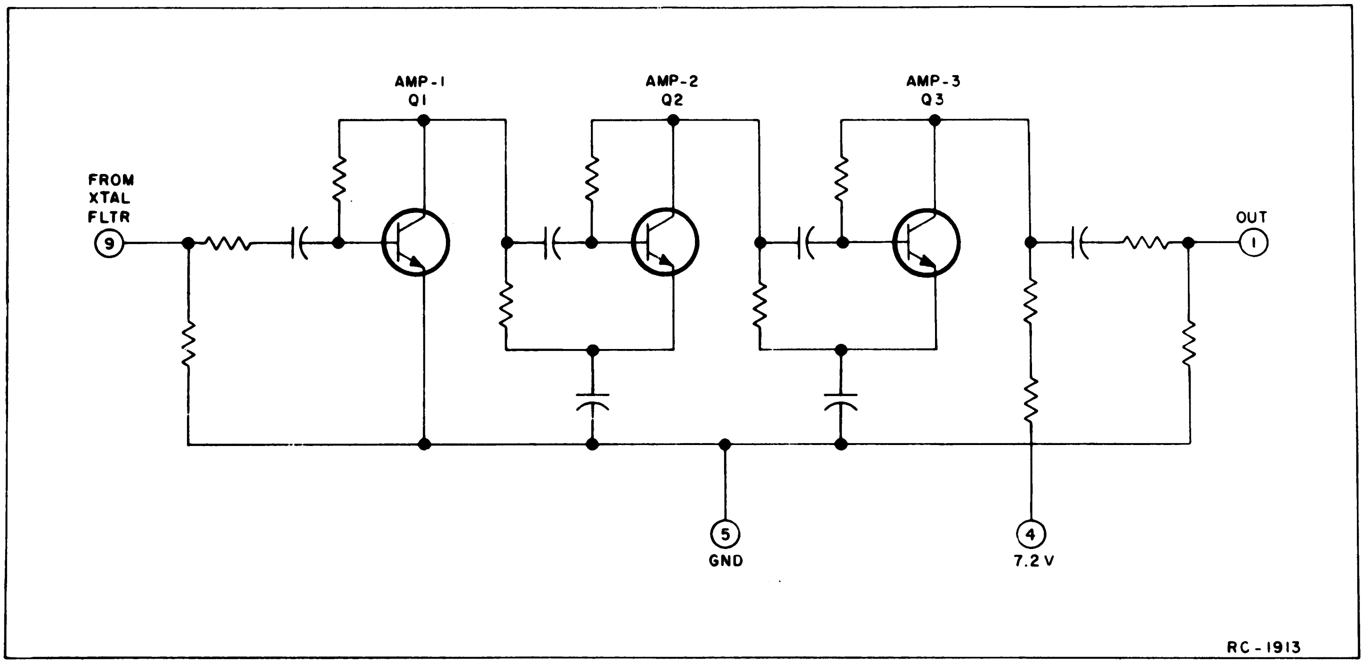


Figure 4 - Typical IF Amplifier Circuit

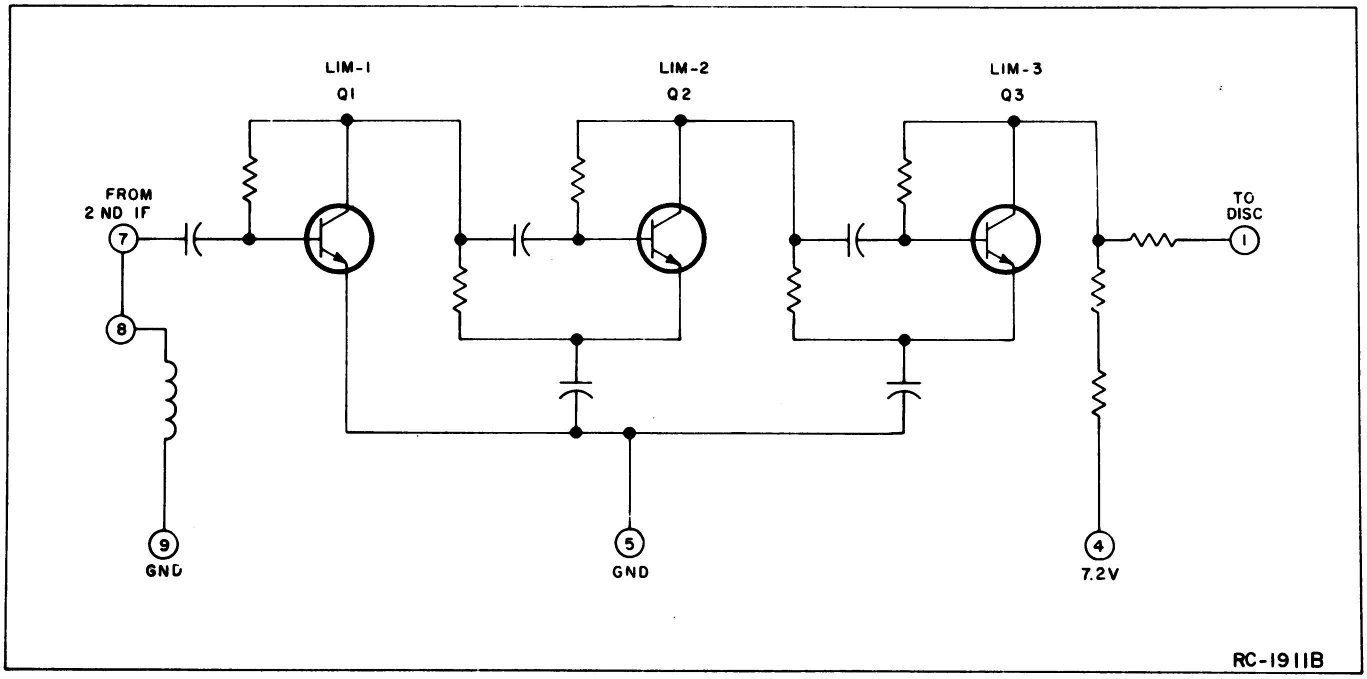


Figure 5 - Typical Limiter Circuit

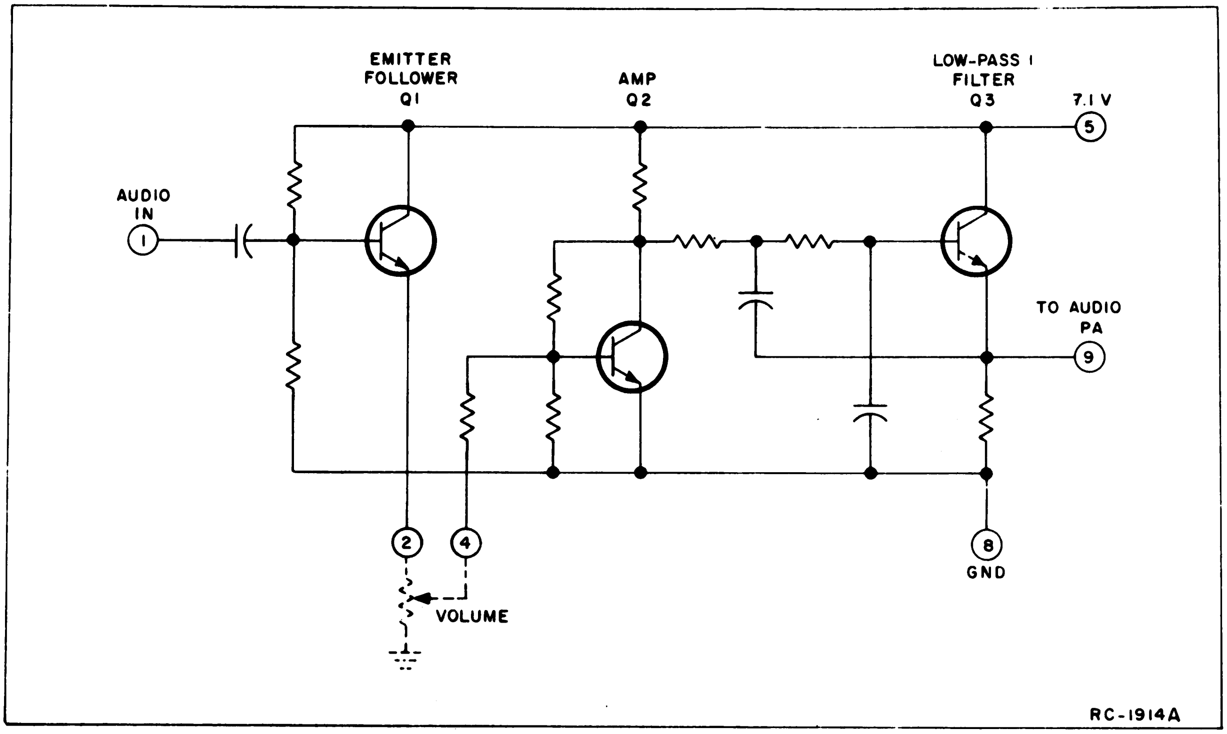


Figure 6 - Typical Audio Amplifier Circuit

is connected from Pin 9 to the Audio PA module. In audio amplifier module A323, an active high-pass filter is added in series with the low-pass filter to provide the required tone frequency roll-off.

AUDIO PA A311

When the receiver is quieted by a signal, audio from the active filter is connected to Pin 1 of audio PA module A311, and then to the base of amplifier Q1. Q1 feeds the audio signal to the base of Q2, which drives PA transistors Q4 and Q5. A typical audio PA circuit is shown in Figure 7.

PA transistors Q4 and Q5 operate as complementary emitter-followers, providing a 500 milliwatt output into an 8-ohm load. Audio from Pin 9 is coupled through capacitor C302 on the receiver board to the loud-speaker.

SQUELCH A312

Noise from audio amplifier A309/A310 operates the squelch circuit. A typical squelch circuit is shown in Figure 8.

When no carrier is present in the receiver, the noise output of active high-pass filter Q1 is coupled to the base of noise amplifier Q2 through SQUELCH control R708. R708 controls the gain of the noise amplifier.

The output of noise amplifier Q2 is detected by diodes CR1 and CR2, and the resultant positive voltage turns off the PNP squelch switch Q3. In standard radios, the emitter of Q3 is connected to +7 Volts by means of a jumper from H1 to H2. When noise turns off Q3, its collector drops to ground potential. As the collector of Q3 is connected to the base of amplifier Q1 in the audio PA module, turning off Q3 also turns off Q1, keeping the audio PA turned off.

When the receiver is quieted by a signal, squelch switch Q3 turns on. This applies +7 Volts to the base of amplifier Q1 in the audio PA module, turning the audio PA circuit on so that sound is heard at the speaker.

In tone decoder applications, the 7-Volt jumper from H1 to H2 is removed. The emitter of squelch switch Q3 is connected to 7.5 Volts by a DC switch on the decoder.

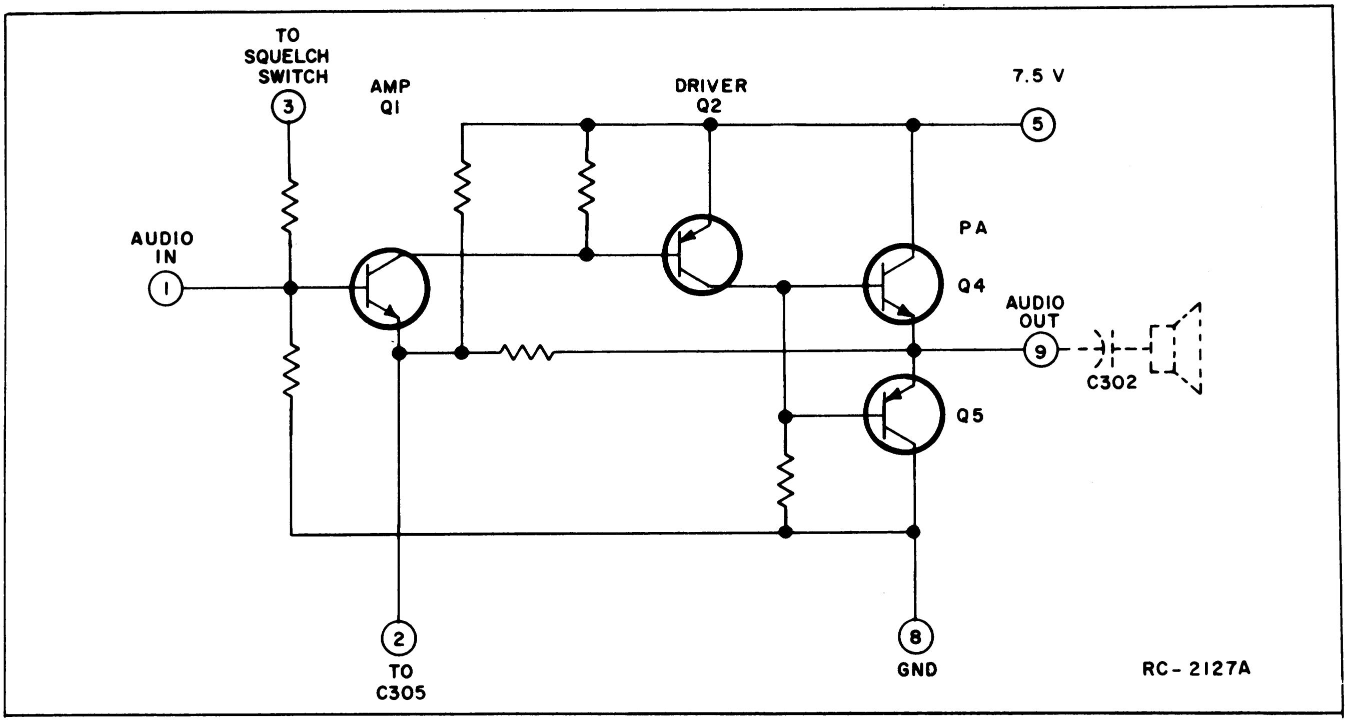


Figure 7 - Typical Audio PA Circuit

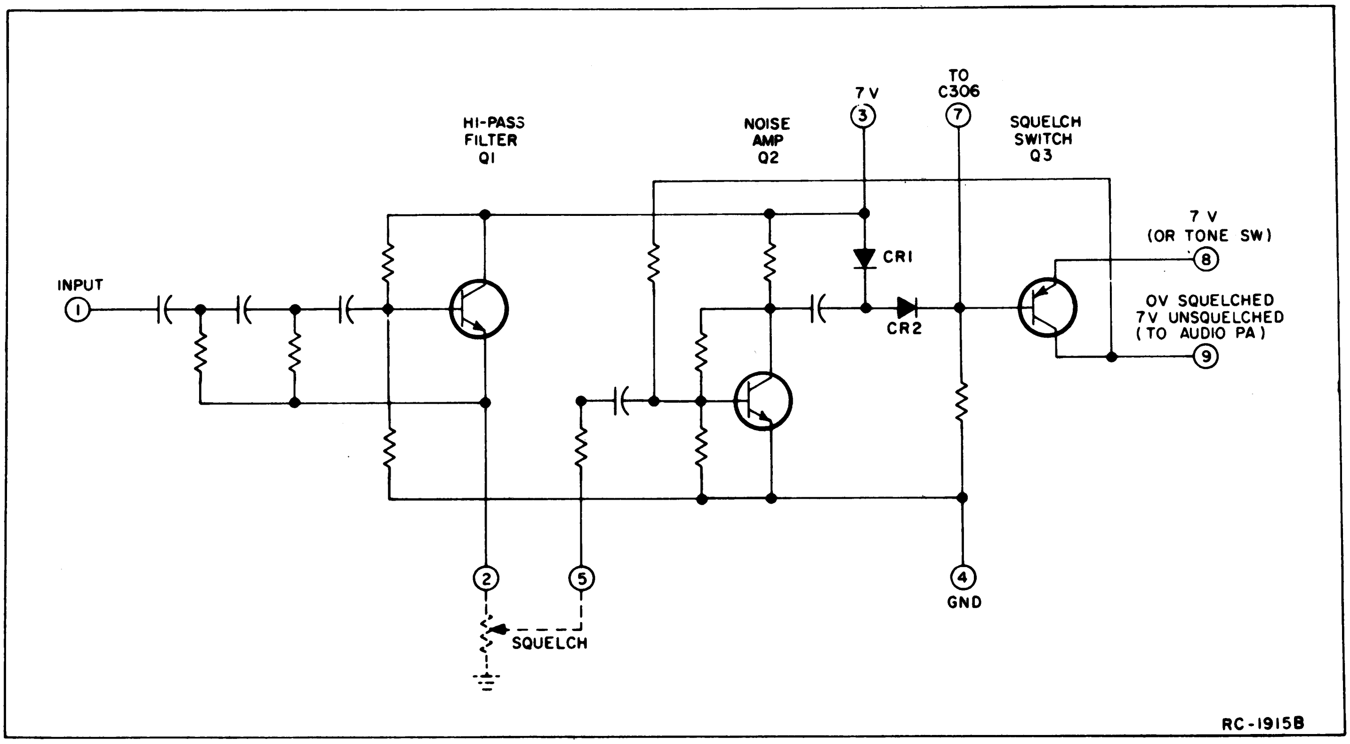
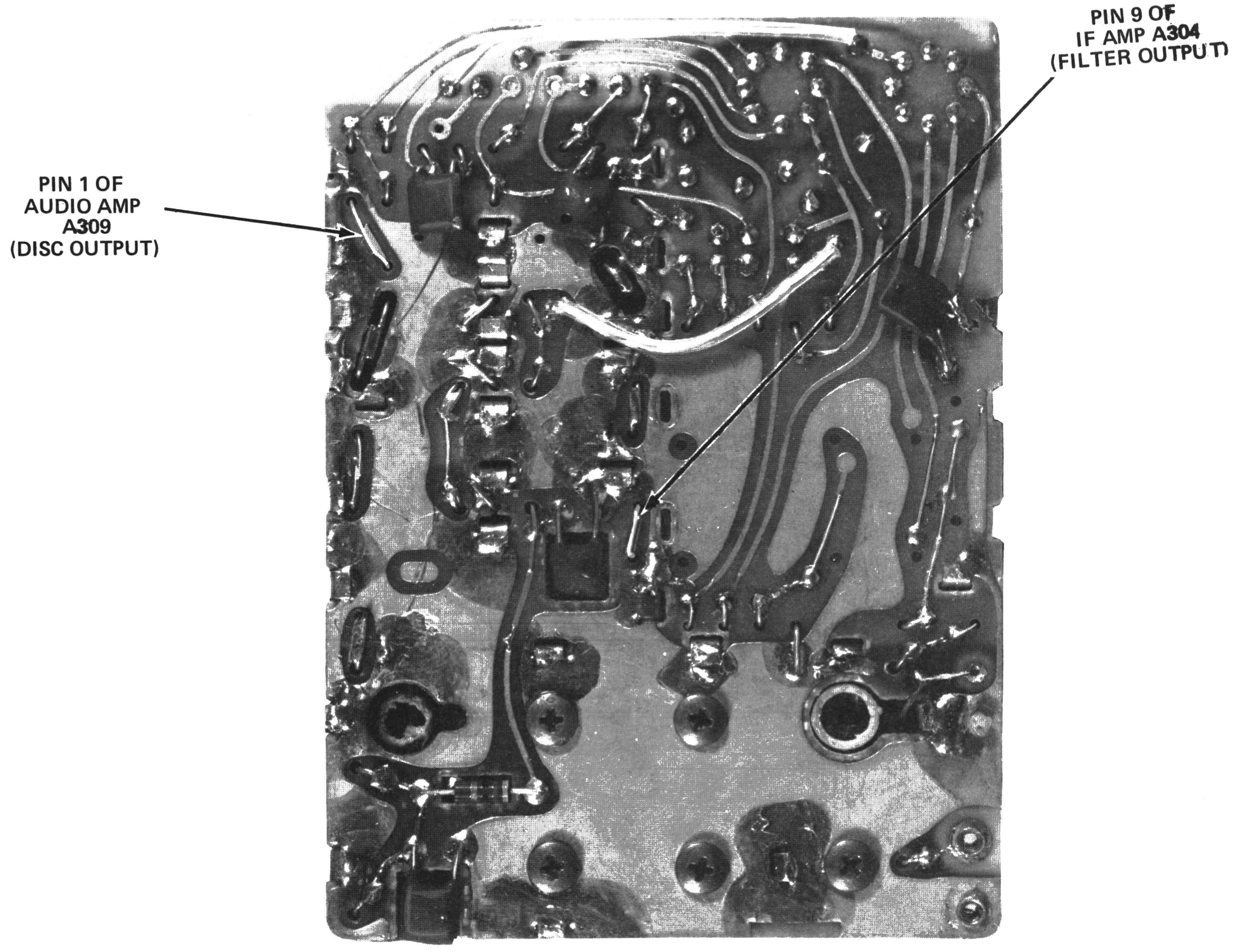
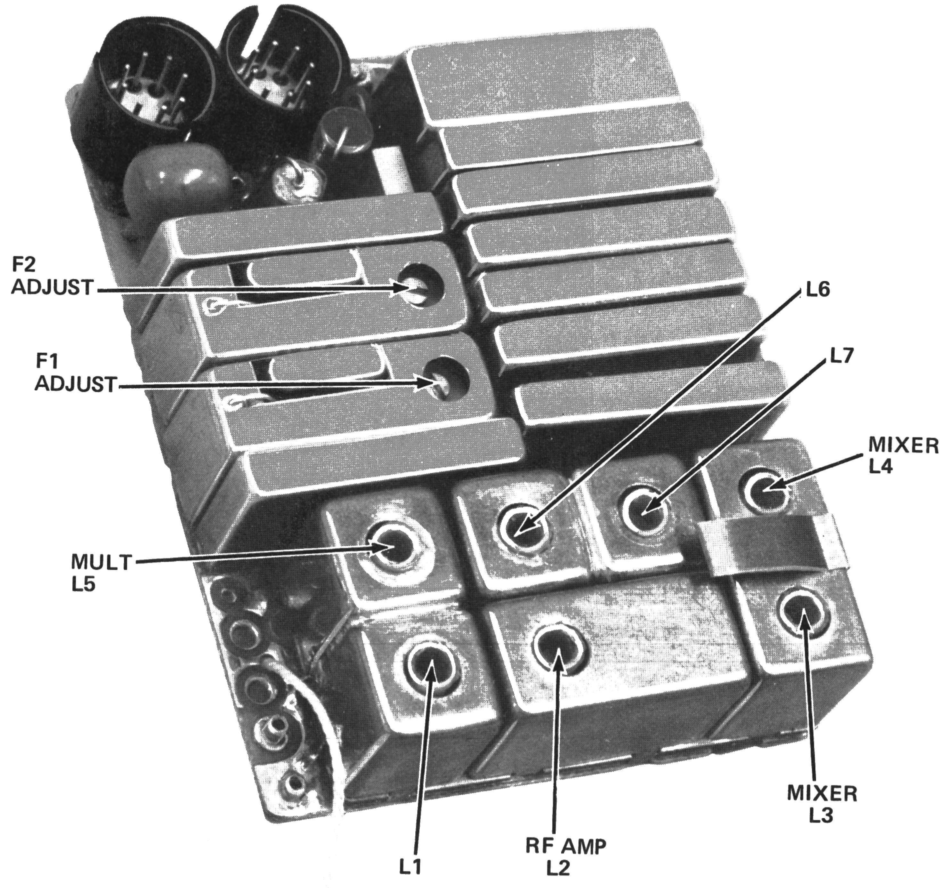


Figure 8 - Typical Squelch Circuit

SOLDER SIDE



COMPONENT SIDE



RECEIVER ALIGNMENT

EQUIPMENT

1. A 20/23 MHz signal source (GE IF Generator Model 4EX9A10 or equivalent) and a 66-88 MHz source connected to Antenna Switch J702 by Receiver Test Cable 19C317633G1.
2. GE Test Amplifier Model 4EX16A10 and RF probe 19C311370G1, or equivalent RF voltmeter.
3. Distortion Analyzer or AC-VTVM.
4. Oscilloscope.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. In multi-frequency receivers where the maximum frequency spacing is less than one MHz, align the receiver on the F1 channel. Where the frequency spacing is more than one MHz, align the receiver on the center frequency.
2. Set the slugs in L1 thru L3 and L5 thru L7 to the bottom of the coil form for frequencies in the high end of the band. Set the slugs near the top of the coil form for frequencies near the low end of the band.
3. Connect the Distortion Analyzer or AC-VTVM across the speaker leads.

STEP NO.	TUNING CONTROL	PROCEDURE
1.	L1 thru L3 L5 thru L7	Apply an on-frequency signal to J702 and adjust L1, L2, L3, L5, L6, and L7 for maximum quieting sensitivity.
2.	Mixer L4	Modulate the signal generator with a 20-Hz sawtooth wave and a level of ±20 kHz deviation. Connect the output of the RF detector probe to the vertical input of an oscilloscope. Adjust the signal level until the bandpass is displayed on the scope when the detector probe input is connected to the input of the first IF amplifier A304-9. Adjust L4 for maximum flatness of display. NOTE Set scope vertical sensitivity to maximum DC sensitivity and sweep rate to 2 ms/cm triggered by the sawtooth wave.
3.	L1 thru L3 L5 thru L7	With a 10 dB quieting signal level, readjust L1, L2, L3, L5, L6 and L7 for maximum quieting.
4.		While applying an on-frequency signal to J702, loosely couple a 20-MHz signal to the Mixer. Adjust the Oscillator trimmer(s) for a zero beat frequency between the two signals. Alternate Method: Apply a strong 20/23 MHz signal to the Mixer. Measure the output of the Discriminator with a DC-VTVM at Pin 1 of A309/A310. Note the reading. Next, remove the 20/23 MHz signal and apply a strong on-frequency signal to J702. Then tune the oscillator trimmer(s) for the meter reading obtained at Pin 1 of A309/A310.

ALIGNMENT PROCEDURE

66—88 MHz RECEIVER
MODELS 4ER87A10, 11, 12 & 13

TEST PROCEDURES

These Test Procedures are designed to help you service a receiver that is operating --- but not properly. The problems encountered could be low power, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency. To check Dual Front End receivers set multi-frequency switch as follows:

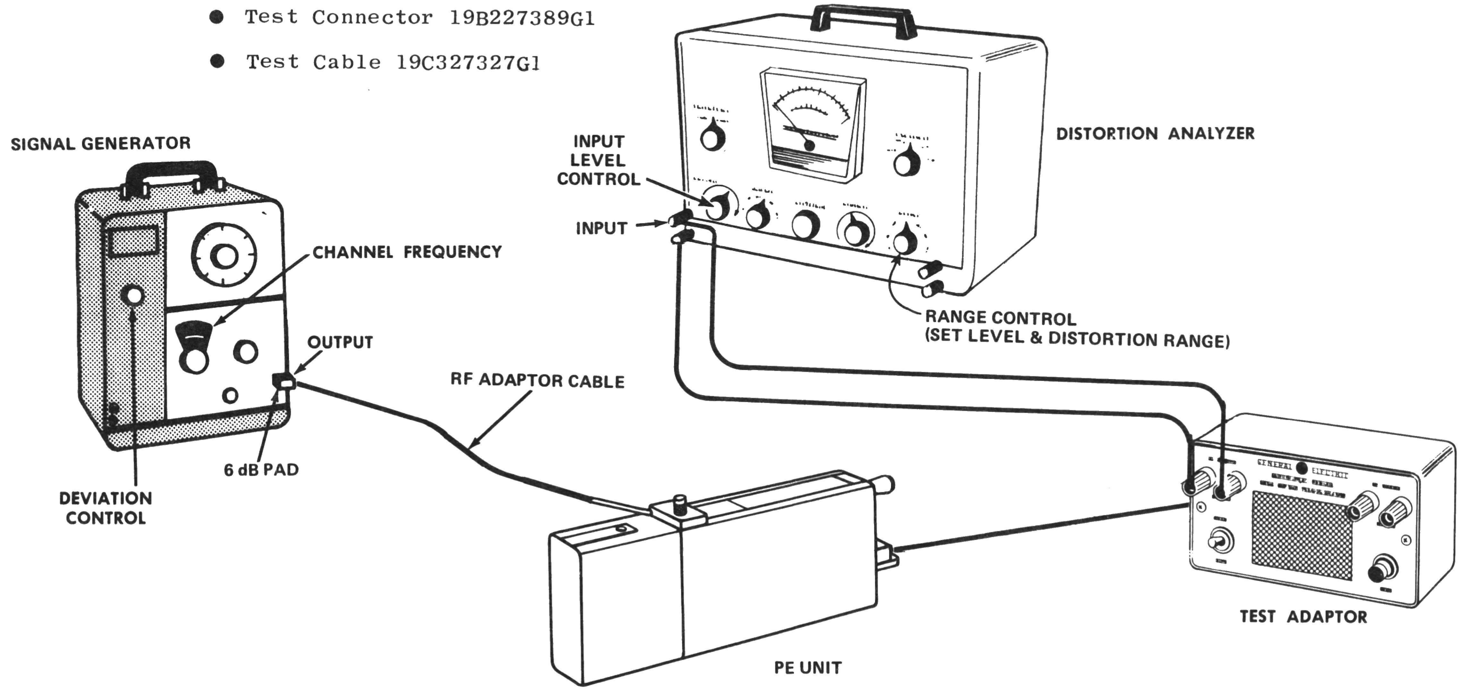
FE#1 Multi-Freq. Switch to F1 or F2
FE#2 Multi-Freq. Switch to F3X

TEST EQUIPMENT REQUIRED

- Distortion Analyzer similar to: Heath IM-12
- Signal Generator similar to: Measurements M-800
- 6-dB attenuation pad
- Test Adaptor Model 4EX12A10
- RF Adaptor Cable 19C317633G1
- Test Connector 19B227389G1
- Test Cable 19C327327G1

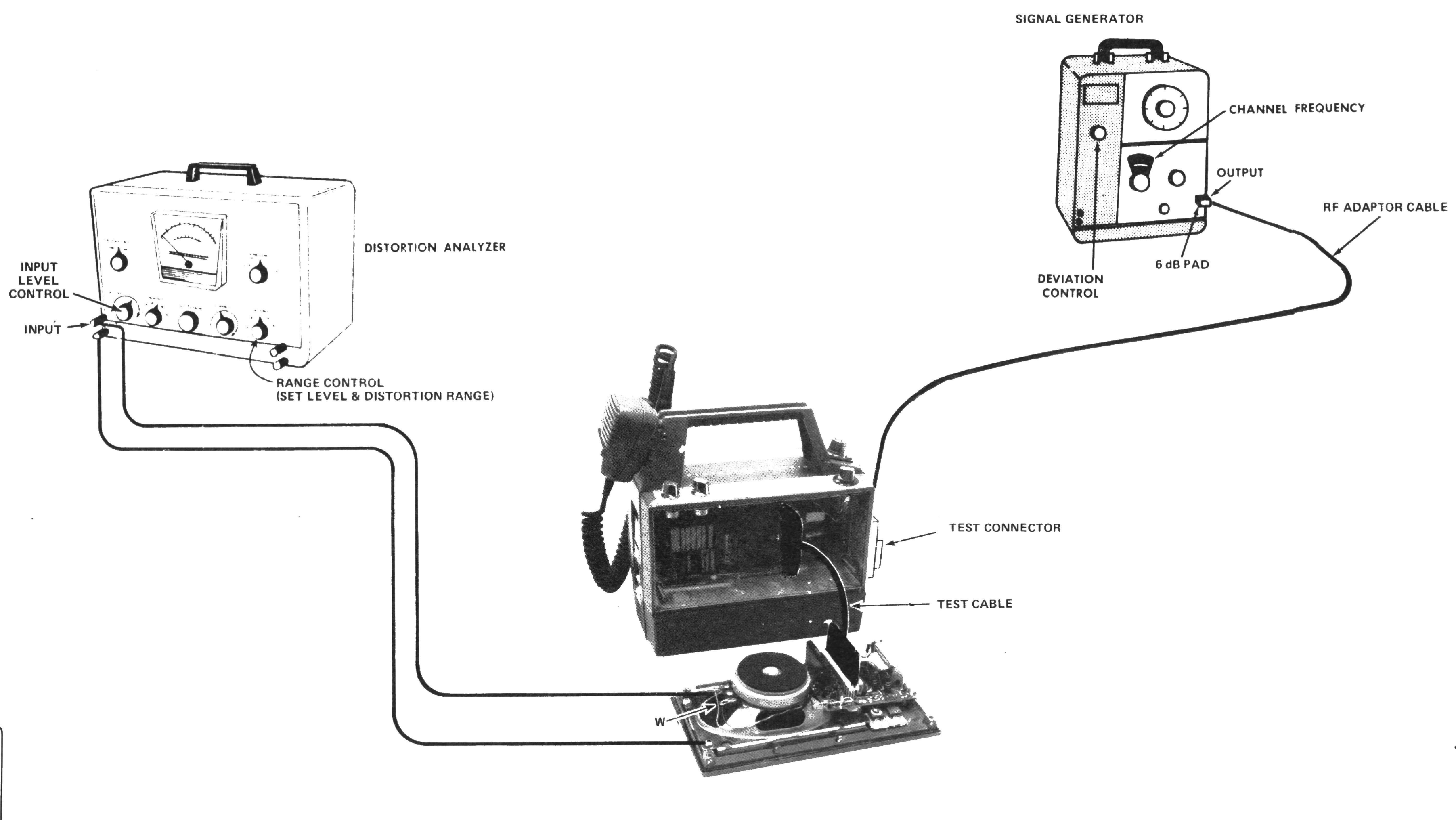
PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



NOTE:

To keep from listening to 10 watts of audio, an 8 ohm resistor, rated at more than 10 watts, may be connected between the the white and blue leads on the speaker. When the resistor is used, the white lead is disconnected from the speaker terminal.



Porta-Mobile II™

STEP 1

AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power output as follows:

A. Connect a 1,000-microvolt test signal modulated by 1,000 hertz ±3.3 kHz deviation to Antenna Switch J702 for PE or J704 for Porta•Mobile II.

B. Set the PE Volume Control for a 500 milliwatt output (2 volts RMS). Set the Porta•Mobile II Volume Control for 10 Watts output (8.9 Volts RMS).

C. Make distortion measurements according to test equipment manufacturer's instructions. Reading should be less than 5%-10% for PE (5% is typical). Reading should be less then 10% for Porta•Mobile II. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5% for PE and 10% for Porta•Mobile II, or maximum audio output is less than 0.5 watt for PE and 10 watts for Porta•Mobile II, make the following checks:

D. Battery voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

E. Audio Gain (Refer to Receiver Troubleshooting Procedure).

STEP 2

USABLE SENSITIVITY (12 dB SINAD)

TEST PROCEDURE

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000-microvolt, on-frequency signal modulated by 1000 Hz with 3.0 kHz deviation to J702.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000-Hz distortion range position (1000-Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12-dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specification with an audio output of at least 250 milliwatts.

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

TEST PROCEDURE

If STEPS 1 and 2 check out properly measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12-dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12-dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

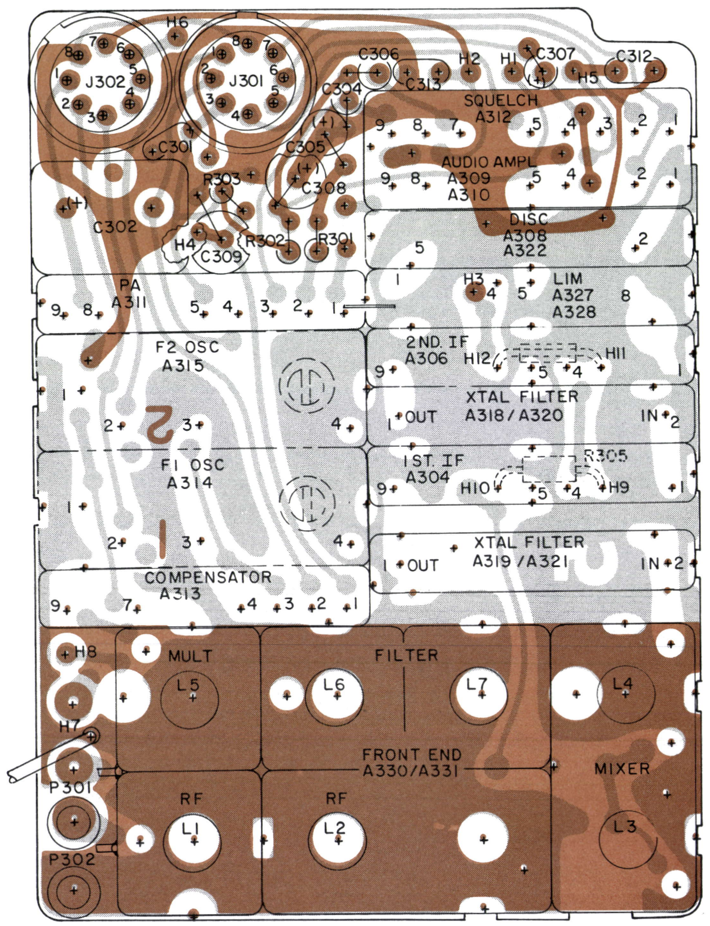
D. The deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

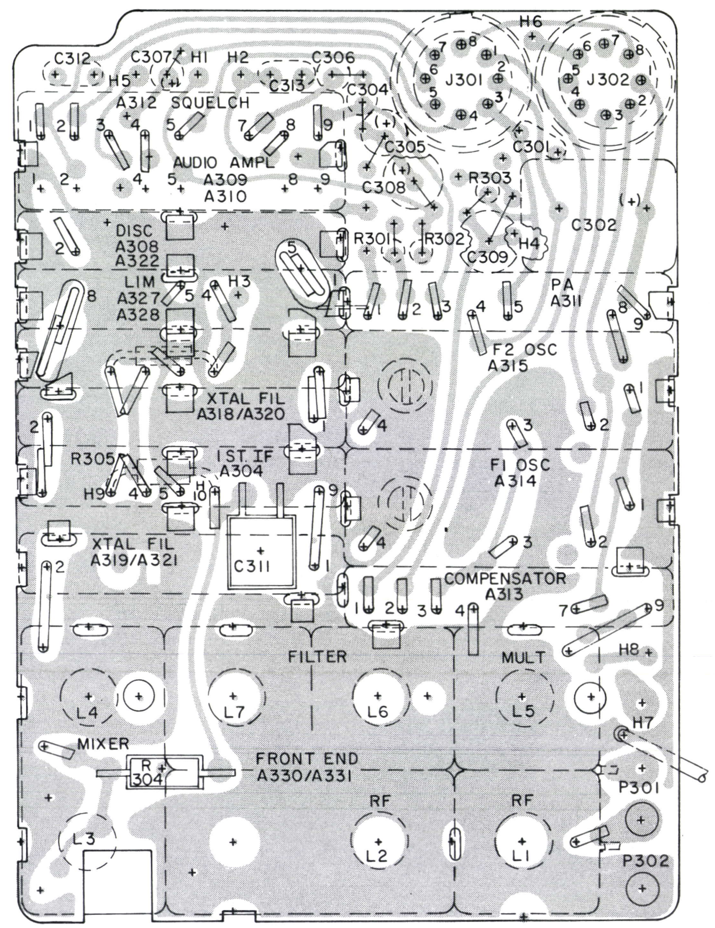
RECEIVER BOARD

COMPONENT SIDE



(19D416852, Sh. 2, Rev. 5)
(19D416852, Sh. 3, Rev. 6)

SOLDER SIDE



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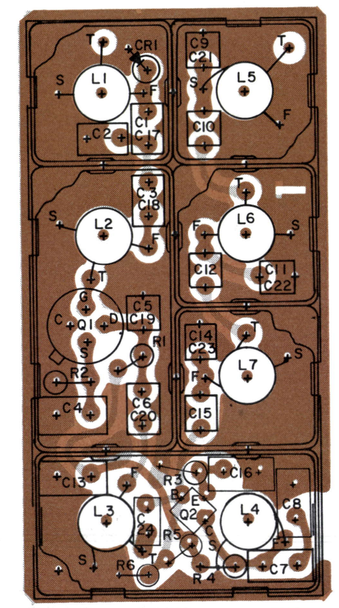
RECEIVER FRONT END

COMPONENT SIDE



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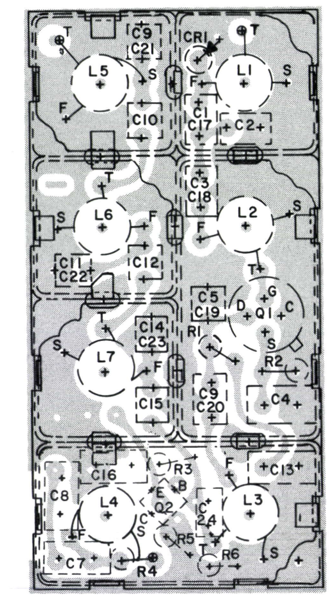
(19D423391, Sh. 3, Rev. 1)

SOLDER SIDE



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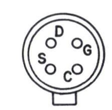
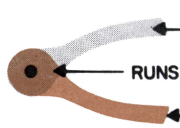


LEAD IDENTIFICATION FOR Q1 VIEW FROM LEAD END

(19C327318, Rev. 2)

(19D424224, Rev. 0)



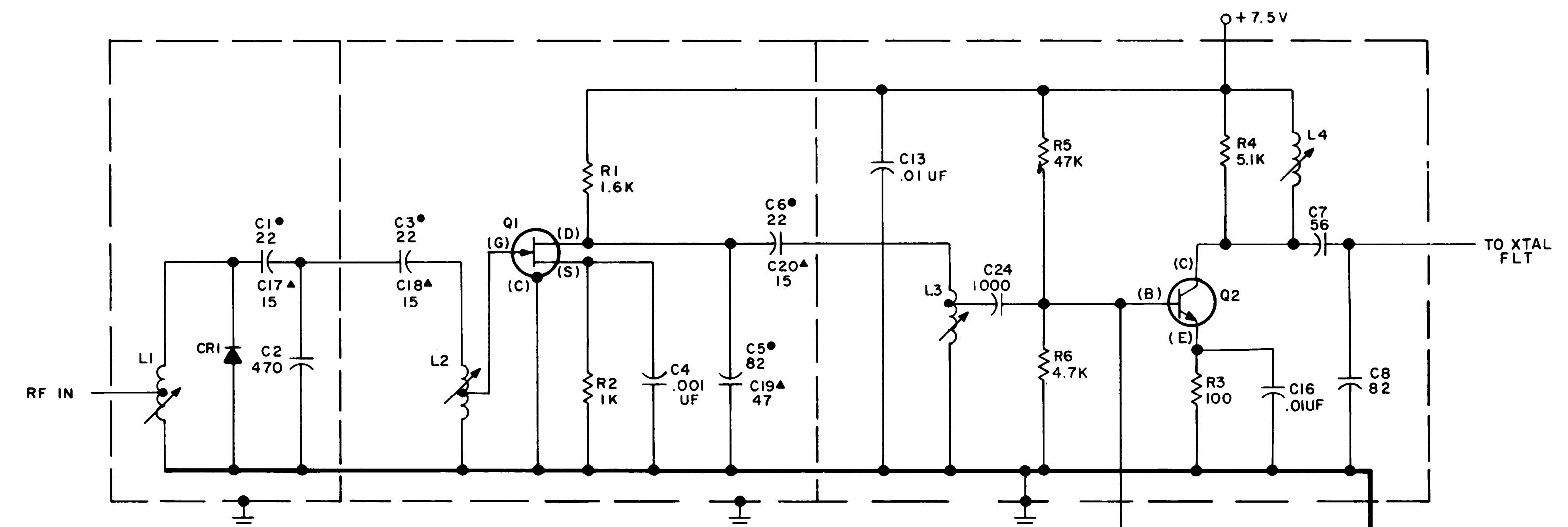
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

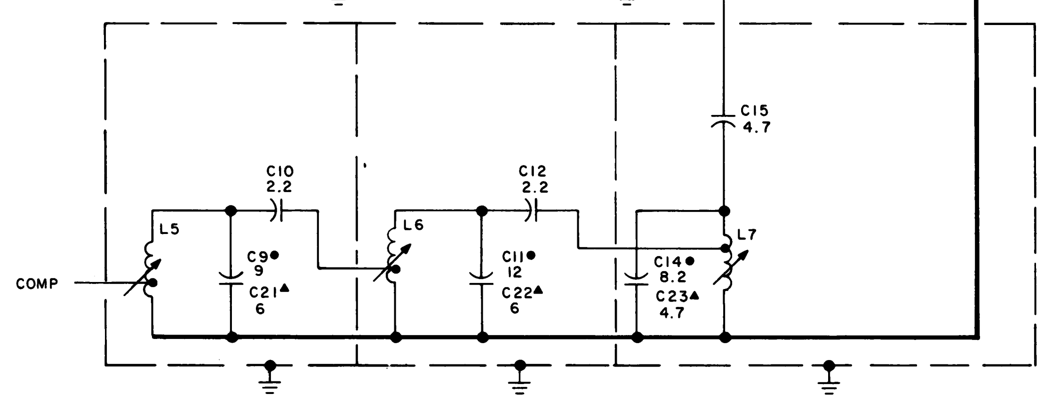
66—88 MHz RECEIVER
MODELS 4ER87A10, 11, 12 & 13

Issue 2

FRONT END



MODEL NO.	REV LETTER
PL19D423395G1	A
PL19D423395G2	A



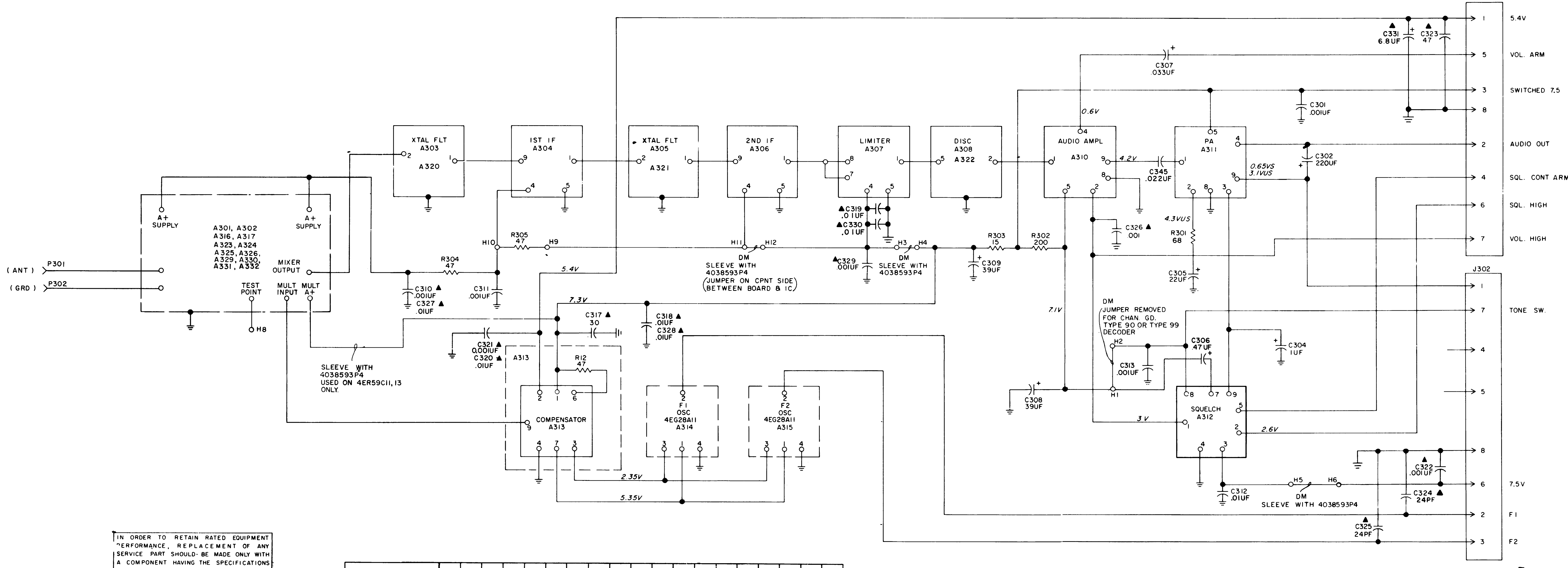
ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

● LO SPLIT 66-76 MHZ (A330)
▲ MID SPLIT 75-88 MHZ (A331)

(19C321714, Rev. 2)

RECEIVER BOARD



IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER	
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417490G1	H
PL19D417490G2	G
PL19D417490G3	G
PL19A130042G1	A
PL19A130042G2	A
PL19A130042G3	A
PL19A130042G4	A
PL19A130042G5	B
PL19A130042G6	A

MODEL NO.	C310	C315	C316	C317	C318	C319	C320	C321	C322	C323	C324	C325	C326	C327	C328	C329	C330	C331	C332
4ER59A10-13 (KIT PL19A130042G1)	X												X						
4ER60A10-13 (KIT PL19A130042G2)	x			x				X	X	X	X	x	x			x			
4ER61A11-13-15-17 (KIT PL19A30042G3)						X	X						X	x	x				
4ER62A10-11 (KIT PL19A130042G4)	X			X	X		X						X						
4ER59C11,13 (KIT PL19A130042G5)	X					X		x					X		X		X	X	
4ER87A10-13 (KIT PL19A130042G6)						X	X						X	X	X				

(19R622035, Rev. 16)

VOLTAGE READINGS

ALL READINGS TAKE WITH A DC-VTVM AND MEASURED TO GROUND. READINGS FOLLOWED BY "S" ARE WITH THE RECEIVER SQUELCHED. READINGS FOLLOWED BY "US" ARE WITH THE RECEIVER UNSQUELCHED.

▲ PART OF MODIFICATION KIT PL19A130042 SEE CHART BELOW FOR SELECTION OF PROPER PARTS FOR APPLICABLE MODEL NO.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SCHEMATIC DIAGRAM

66—88 MHz RECEIVER
MODELS 4ER87A10, 11, 12 & 13

PARTS LIST

LBI30185A

66-88 MHz RECEIVER
MODEL 4ER87A10,A11 STANDARD
MODEL 4ER87A12,A13 CHANNEL GUARD

SYMBOL	GE PART NO.	DESCRIPTION
A330 and A331		FRONT END A330 19D423395G1 66-76 MHz A331 19D423395G2 76-88 MHz
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116192P2	Ceramic: 470 pf ±20%, 50 VDCW; sim to Erie 8111-A050-W5R-471M.
C3	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C4	19A116192P13	Ceramic: 1000 pf ±10%, 50 VDCW; sim to Erie 8121-A050-W5R-102K.
C5	19A116114P6062	Ceramic: 82 pf ±5%, 100 VDCW; temp coef -470 PPM.
C6	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C7	19A116114P2056	Ceramic: 56 pf ±5%, 100 VDCW; temp coef -80 PPM.
C8	19A116114P6062	Ceramic: 82 pf ±5%, 100 VDCW; temp coef -470 PPM.
C9	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C10	19A116114P8	Ceramic: 2.2 pf ±5%, 100 VDCW; temp coef 0 PPM.
C11	19A116114P2033	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM.
C12	19A116114P8	Ceramic: 2.2 pf ±5%, 100 VDCW; temp coef 0 PPM.
C13	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C14	19A116114P2028	Ceramic: 8.2 pf ±5%, 100 VDCW; temp coef -80 PPM.
C15	19A116114P2016	Ceramic: 4.7 pf ±5%, 100 VDCW; temp coef -80 PPM.
C16	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C17 and C18	19A116114P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C19	19A116114P2053	Ceramic: 47 pf ±5%, 100 VDCW; temp coef -80 PPM.
C20	19A116114P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C21 and C22	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C23	19A116114P2016	Ceramic: 4.7 pf ±5%, 100 VDCW; temp coef -80 PPM.
C24*	5495323P12	Ceramic: 0.001 µf +100 -20%, 75 VDCW. Added by REV A.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C320379G13	Coil. Includes:
	19B209436P1	Tuning slug.
L2 and L3	19B226958G2	Coil.
L4	19C320379G11	Coil. Includes:
	19B209436P1	Tuning slug.
L5	19C320379G15	Coil. Includes:
	19B209436P1	Tuning slug.
L6 and L7	19B226958G1	Coil.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A116960P1	N Type, field effect; sim to Type 2N4416.
Q2*	19A116159P1	Silicon, NPN.
		Earlier than REV A:
	19A116960P1	N Type, field effect; sim to Type 2N4416.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P162J	Composition: 1.6K ohms ±5%, 1/8 w.
R2	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
R3*	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
		Earlier than REV A:
	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
R4*	3R151P512J	Composition: 5.1K ohms ±5%, 1/8 w.
		Earlier than REV A:
	3R151P203J	Composition: 20K ohms ±5%, 1/8 w.
R5*	3R151P473J	Composition: 47K ohms ±5%, 1/8 w. Added by REV A.
R6*	3R151P472J	Composition: 4.7K ohms ±5%, 1/8 w. Added by REV A.
		RECEIVER BOARD 19D417490G1 66-76 MHz 19D417490G3 76-88 MHz
A303	19C304824G1	Band Pass Filter. 66-76 MHz.
A304	19C311879G3	IF Amplifier.
A305	19C304824G1	Band Pass Filter. 66-76 MHz.
A306	19C311879G4	IF Amplifier.
A307	19C311876G4	Limiter. 76-88 MHz.
A308	19C304504G3	Discriminator.
A309*	19C311878G2	Audio Amplifier. Deleted in G3 by REV G.
A310	19C311995G4	Audio Amplifier, Tone Filter.
A311*	19C311877G4	Audio PA.
		In G1 of REV F & earlier, G3 of REV E & earlier:
	19C311877G2	Audio PA.
A312	19C311880G4	Squelch.
A313	19C320061G1	Oscillator Compensator.
		- - - - - - - - - - - OSCILLATORS - - - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
A314 and A315	4EG28A30	Oscillator Module. 66-76 MHz. $Fx = \frac{Fo + F_{IF}}{5}$
A314 and A315	4EG28A31	Oscillator Module. 75-88 MHz. $Fx = \frac{Fo + 23}{5}$
A320 and A321	19C304824G3	Band Pass Filter.
A322	19C304504G6	Discriminator.
A327	19C311876G4	Limiter.
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C301	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C302	19A116178P7	Tantalum: 220 µf ±20%, 6 VDCW.
C303*	19A116089P1	Ceramic: 0.1 µf ±20%, 50 VDCW, temp range -55 to +85°C. Deleted in G1 by REV F, G3 by REV E.
C304	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C305	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C306	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C307	5491674P31	Tantalum: 0.033 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C308 and C309	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C311	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C312	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C313	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C314*	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW. Deleted in G1 by REV E, G3 by REV D.
C345*	19A116192P6	Ceramic: 0.022 µf ±20%, 50 VDCW; sim to Erie 8131-M050-W5R-223M. Added to G1 by REV F, G3 by REV E.
		- - - - - - - - - JACKS AND RECEPTACLES - - - - - -
J301 and J302	19A116122P1	Terminal, feed-thru: sim to Warren Co. 1-B-2994-4.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P301 and P302	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R301*	3R151P680J	Composition: 68 ohms ±5%, 1/8 w.
		In G1 of REV D & earlier: In G3 of REV C & earlier:
	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R302	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
R303	3R151P150J	Composition: 15 ohms ±5%, 1/8 w.
R304 and R305	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
		CAPACITOR KIT 19A130042G6
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C319 and C320	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C326*	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW. Added by REV A.
C327 and C328	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19B216316P1	Insulator. (Used with J301, J302).
	4035306P11	Washer, fiber. (Used with Q1, Q2 on Front End).
	19A127737P1	Spring, ground tab. (Soldered to Front End can).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter," which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A Thur F - Receiver Board 19D417490G2
REV. A Thur E - Receiver Board 19D417490G3
Incorparted into initial shipment.

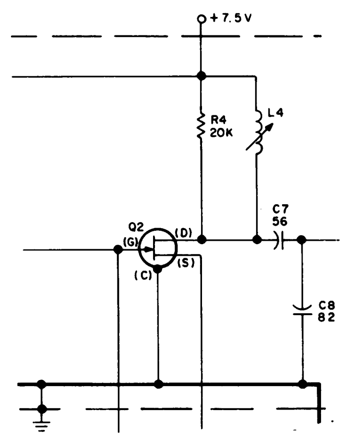
REV. G - Receiver Board 19D417490G2
REV. F - Receiver Board 19D417490G3
To improve auido quality.
Changed A311.

REV. H - Receiver Board 19D417490G2
Receiver Board 19D417490G3
To eliminate non Channel Guard receiver boards.
Deleted Callout of ■A309 and circle (●) in front of A310.
Deleted callout of ■C303 .1µf.
Deleted just the (●) for C345.
Deleted NOTES: ■Use for non Channel Guard receivers and ●Use for Channel Guard receiver.

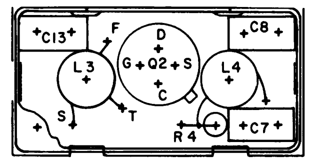
REV. A - Capacitor Kit 19A130042G6
To improve IF filtering.
Added C330.

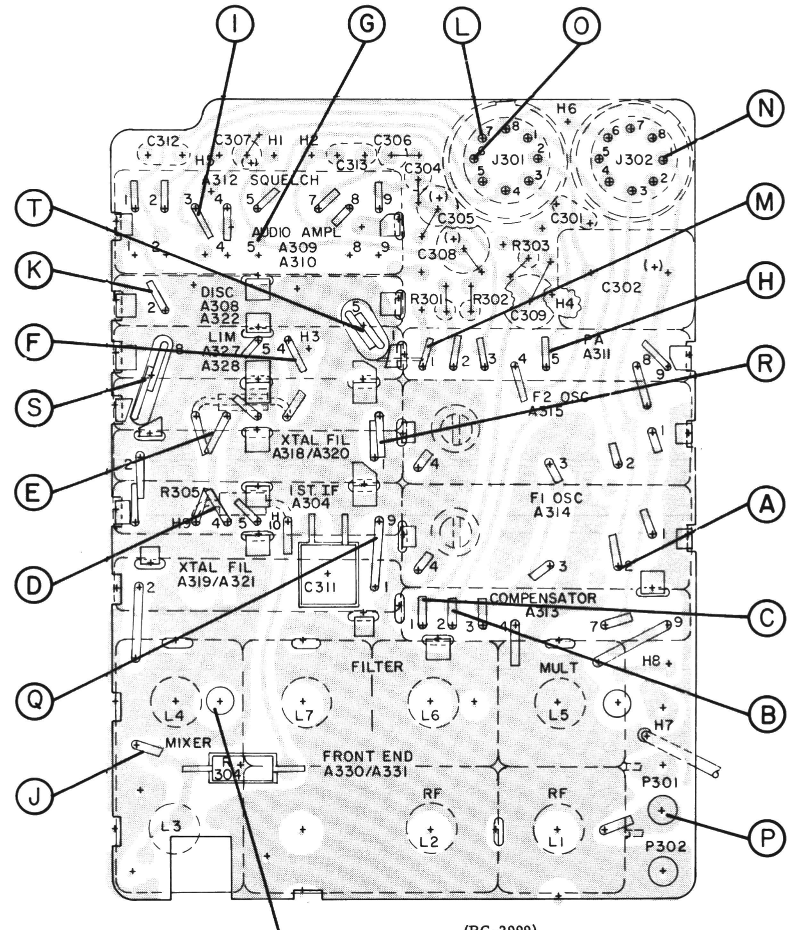
REV. A - Front End 19D423395G1 & G2
To improve sensitivity.
Changed R3, R4, and Q2.
Added C24, R5 and R6.

Schematic Diagram was:



Outline Diagram was:





INJECTION
VOLTAGE
TEST POINT

(RC-2999)
(19D424224, Rev. 0)
(19D416852, Sh. 2, Rev. 5)

QUICK CHECKS

SYMPTOM	PROCEDURE
No audio	1. Check audio waveform at the top of the Volume Control (see Step 2). 2. If audio is present, check voltage readings of Audio and Squelch modules (see Schematic Diagram). 3. If audio is not present, check gain and current readings of Front End and IF modules (see Steps 1 & 3).
Poor Sensitivity	1. Measure the injection voltage for a minimum level of 400 millivolts. If the reading is low, check the output of the Oscillator and Compensator modules with an RF voltmeter. 2. Measure the gain of the Mixer stage (see Step 3). If low, measure the gain of the RF amplifier and IF modules.
Improper Squelch Operation	1. Check the noise waveform at the input to the Squelch module and at Squelch Control high (see Step 2). 2. Measure the DC voltages for the Squelch module (squelched and unsquelched).

STEP 3-RF GAIN CHECKS
(STEPS P THRU T)

EQUIPMENT REQUIRED:

1. RF probe and Test Amplifier Model 4EX16A10 connected to GE Test Set Model 4EX3A11, or an RF voltmeter.
2. A signal generator (M-800 or equivalent) connected to P301 (High) and P302 (Low).

PROCEDURE FOR MIXER & 1ST IF:

1. Switch the Test Set to the Test 1 position and the Test Amplifier to the X50 position.
2. Connect the RF probe across the input of the stage to be measured as shown on the diagram. Increase the signal generator output to obtain a reference reading on Test Set 4EX3A11. Note the Test Set reading and the dB reading on the generator (dB1).
3. Connect the RF probe to the output of the stage to be measured as shown on the diagram. Decrease the generator output until the Test Set reference reading in Step 2 is obtained. Note the dB reading on the generator (dB2).
4. Subtract the dB1 reading from the dB2 reading and check the results with the typical gains shown on the diagram.

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              35 dB (dB2)
Example:     -15 dB (dB1)
             ------
              20 dB gain
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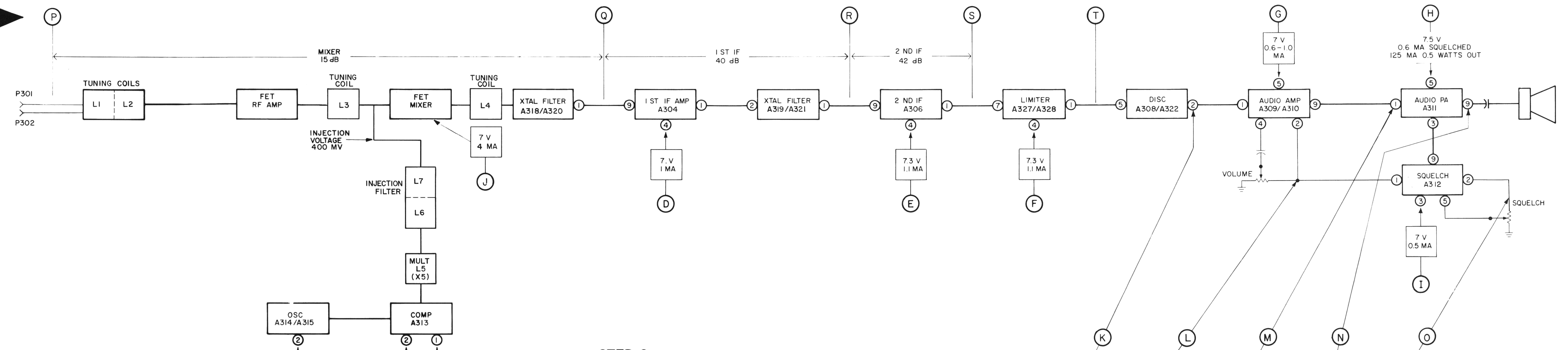
PROCEDURE FOR 2ND IF:

1. With no signal in, connect the RF probe to the output of the 2nd IF module. Increase the signal generator output until the Test Set reading increases by approximately 0.2 volt. Note Test Set and signal generator reading (dB2).
2. Connect the probe to the input of the 2nd IF module. Increase the signal generator until the Test Set reference reading is obtained, and note the dB reading (dB1).
3. Now subtract dB2 from dB1 to obtain the gain of the 2nd IF amplifier module.

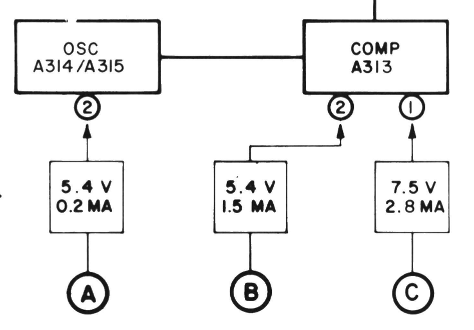
LIMITER CHECK

The Limiter module limits the noise so that the gain of the circuit cannot be measured. The following procedure provides a check to determine if the module is limiting.

1. Switch the Test Amplifier to the X1 position and the Test Set to the Test 1 position. Then connect the RF probe to the output of the Limiter module and check for a reading of approximately 0.4 volt.
2. Increase the signal generator output. There should be no appreciable increase in the limiter output meter reading.



STEP 1-
MODULE CURRENT CHECKS
(STEPS A THRU J)



These current readings provide a method of checking the operation of each Integrated Circuit module using a milliammeter (Triplett 630 or equivalent).

1. Unsolder the + lead as shown in the Diagram of the module to be checked.
2. Connect the milliammeter in series with the + lead, and check for the indicated current drain and supply voltage. No current drain indicates that the module should be replaced.

CAUTION

When checking the current of Audio PA module A311, do not short Pin 4 to ground or to + (Pin 5). To do so will destroy the Audio PA module.

STEP 2 -
AUDIO & SQUELCH WAVEFORMS
(STEPS K THRU O)

EQUIPMENT REQUIRED:

- Oscilloscope connected between the points shown and ground.
- Signal Generator (Measurements M-800 or equivalent).

PRELIMINARY STEPS:

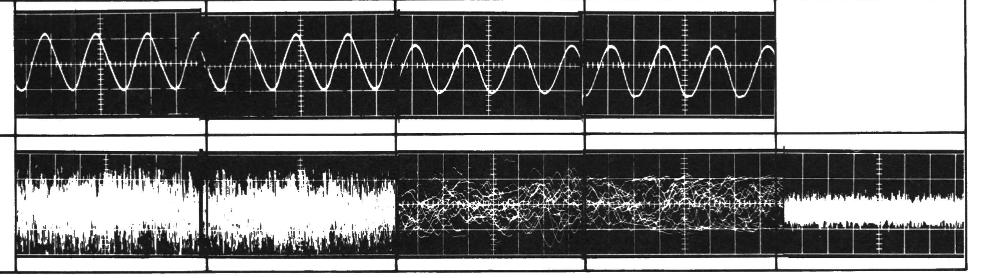
1. Apply a standard signal to P301. A standard signal is 1000 microvolts on the receiver frequency modulated by one kHz with 3.0-kHz deviation.
2. Set the Volume control for 0.5-watt output.

SCOPE SETTINGS

PEAK-TO-PEAK READINGS		K	L	M	N	O
	SIGNAL	0.35 V	0.35 V	0.25 V	5.6 V	
	NOISE	0.9 V	0.9 V	0.25 V	5.6 V	0.7 V

STANDARD SIGNAL

NOISE WAVEFORM



RC-2996

TROUBLESHOOTING PROCEDURE

66—88 MHz RECEIVER
MODELS 4ER87A10, 11, 12 & 13